Standalone GPS Receivers

Still Relevant Today?

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Topics

- Use Cases
- GPS Accuracy
- Smartphones
- GPS Receivers
- Questa Maps

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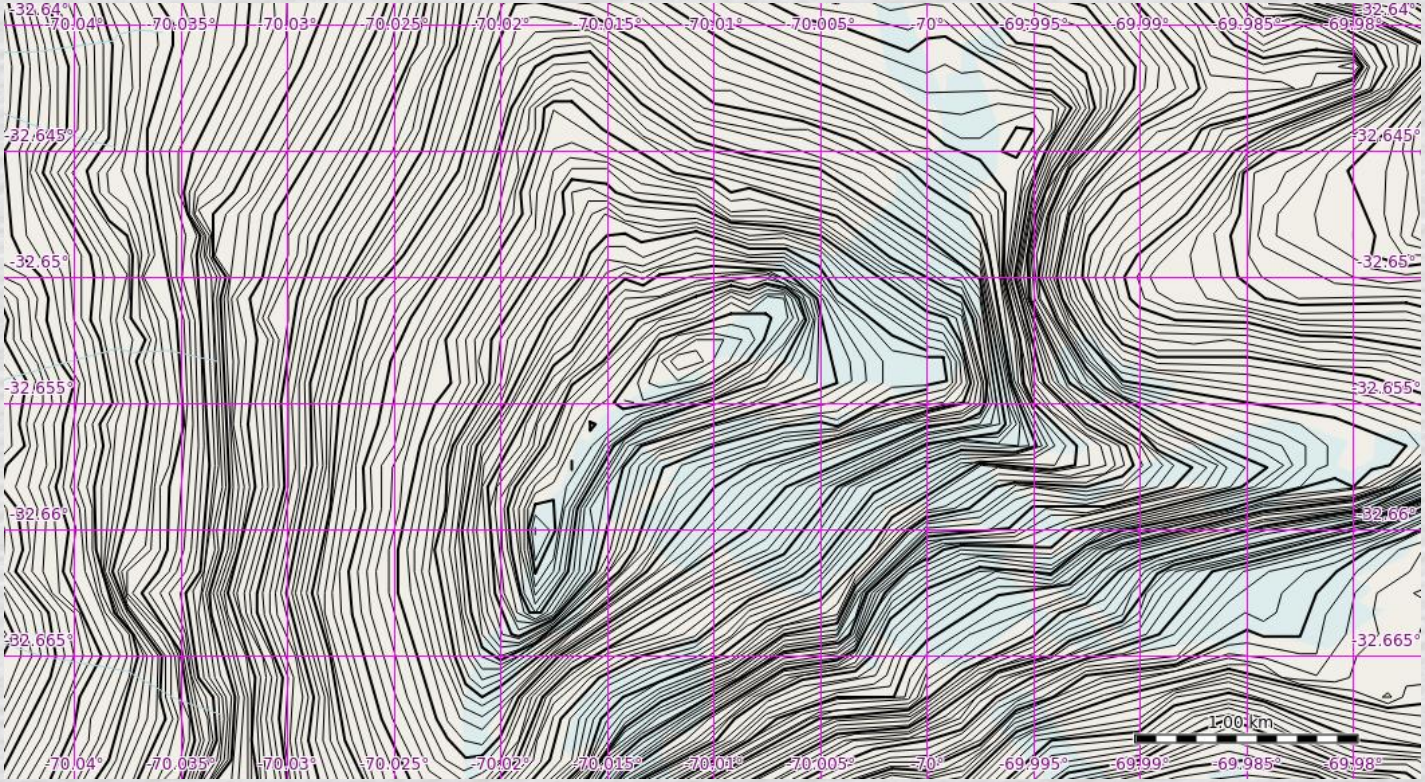
Nice Map ;)


-32.64°
-70.04°
-70.035°
-70.03°
-70.025°
-70.02°
-70.015°
-70.01°
-70.005°
-70°
-69.995°
-69.99°
-69.985°
-69.98°
-32.645°
-32.65°
-32.655°
-32.66°
-32.665°
1.000 km

GPS Use Cases

- Navigation by Public
- Every Day
  - Auto, locate restaurant, store, follow a path
  - 2D World
  - Mistake? - take next right (city based)
- A “Trying” Day
  - Off trail, adverse conditions, return base-camp, research
  - 3D World
  - Mistake? - bad. (remote)

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GPS Accuracy

- Position
  - How close to true
- Reliable
  - Consistency between measurements
- Integrity
  - Satellites operating “correctly”

- Error Sources
  - GPS satellite system, receivers, geography

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Accuracy – Fiendishly Complex

- Multiple – variable, random, interactive conditions
  - Difficult to measure or adjust for in timely manner

- Error Sources (+/- m)
  - "Up There" SBAS correctable
    - Ephemeris (2.5), clock drift (2), signal arrival (3), ionospheric (5), tropospheric (humidity) (0.5)
  - "Down Here"
    - Multi-path (1), satellite constellation geometry, obstructions, receiver noise/design, user errors…

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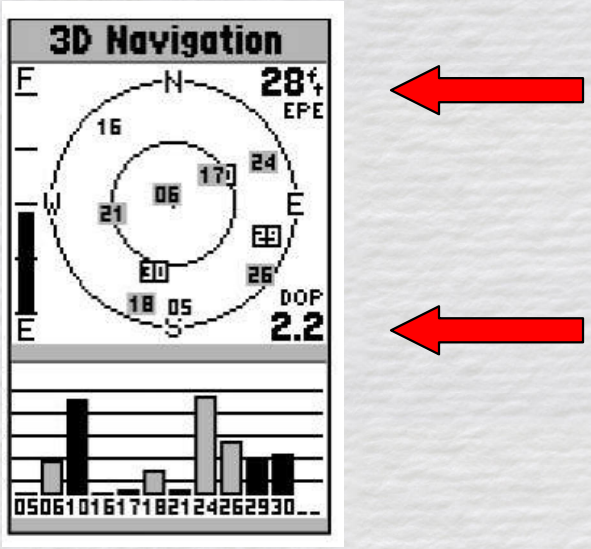
Position Accuracy



Position Accuracy

- EPE “Estimated Position Error”
  - Horizontal (elliptical plot)
  - 50% of positions within EPE (50% are outside)
  - 95% confidence level EPE x 2.27
  - Vertical EPE x 3
- DOP “Dilution of Precision”
  - Satellite constellation geometry, “how sensitive to changes”
  - Confidence level –> 1-5 => Good, 6+ => Careful
- Always an Estimate…Always

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Device EPE

- Garmin
  - L1 - 15m, GNSSs – 9m, WAAS - 3m, L5 - 1m
  - Calculated now
- Smartphone
  - L1 – 15-60+m, A-GPS – ???, faster startup
  - As reported by GPS chip vendors – optimistic ? ;()
  - As designed, not calculated now
- How Much Accuracy is Required?

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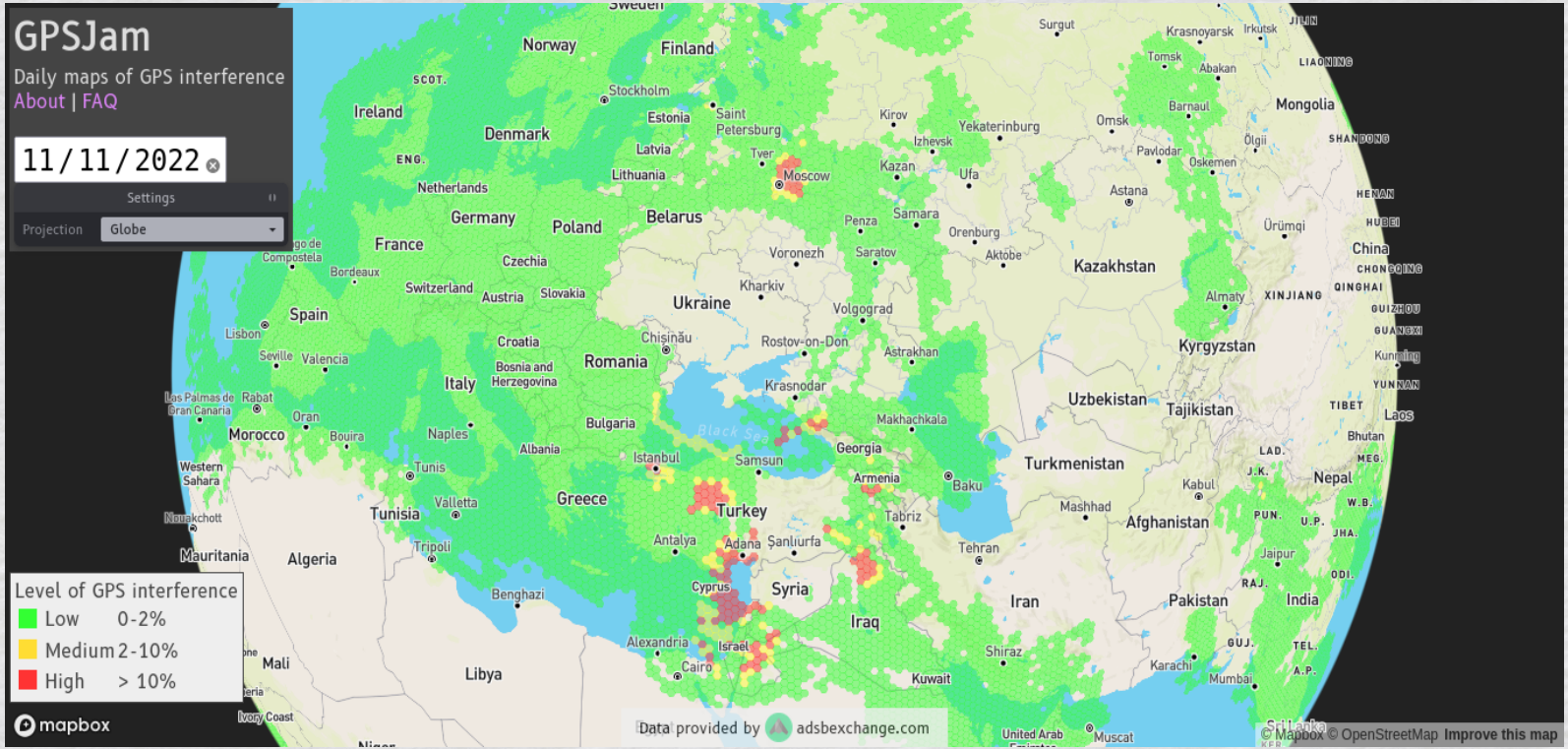
Intentional Signal Interference



Smartphones

- Which Smartphone?
  - 1,430,000,000 (2021 unit sales)
  - Wide range of models, features - simple to complex
  - Position Data - GPS chip set, A-GPS, None

Smartphones

- Advantages
  - Large, dynamic market
  - Many vendors, rapid development cycles
  - Ubiquitous
  - Displays – larger, higher resolution
  - App ecosystem, familiar user interface
  - Maps
    - Google (and friends), maps.me, osmand, topo.com

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Smartphones

- Disadvantages
  - A-GPS only –> data connection to GPS cache server
  - Positioning - Horizontal (no elevation data)
  - Fragile, not water resistant, battery life/recharge?
  - Low margins -> cost pressures -> GPS chips
  - Higher accuracy -> higher cost $1,000+
  - OS vulnerabilities
  - Data scraping – Carriers, Apps, Social Media, Trackers

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GPS Receivers

- Advantages
  - Higher accuracy – L5, SBAS, GNSSs
  - Higher quality - antenna (dual frequency helix), chip set, design, algorithms, signal processing, sat comms
  - GPS core strength (aviation, marine, watches, surveying)
  - Rugged – IPX7/MIL-STD-810, AA battery, autonomous
  - Navigation feature set, track export - GPX format
  - Maps – free and commercial – OSM, hunting, public agencies

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GPS Receiver

- Disadvantages
  - Single vendor US (100,000 units/yr ?)
  - Slow development cycle, legacy product?
  - Map format – proprietary, reverse engineered
  - Interface – 1990’s - complicated, confusing
  - Display – small, low resolution
  - Standalone device, $350 ($200 - $900)

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Which is Best?

- Every Day Use
  - Convenience, multiple uses, lower accuracy, city
  - Smartphone is your bestie
  - GPS device is more than you need

Which is Best?

- “Trying” Day Use
  - Accuracy, elevation, rugged, extended trips, remote areas
  - GPS device is your partner
  - Smartphone maybe

Questa Maps

- Digital topographical maps for GPS receivers
  - OSM geographic data
  - Contours (m) 30 => 15, NASADEM or AW3D data
  - Display adjusted for hiking
  - Worldwide coverage by country, Polar regions
  - Install via SD card
  - Free (conditions apply)

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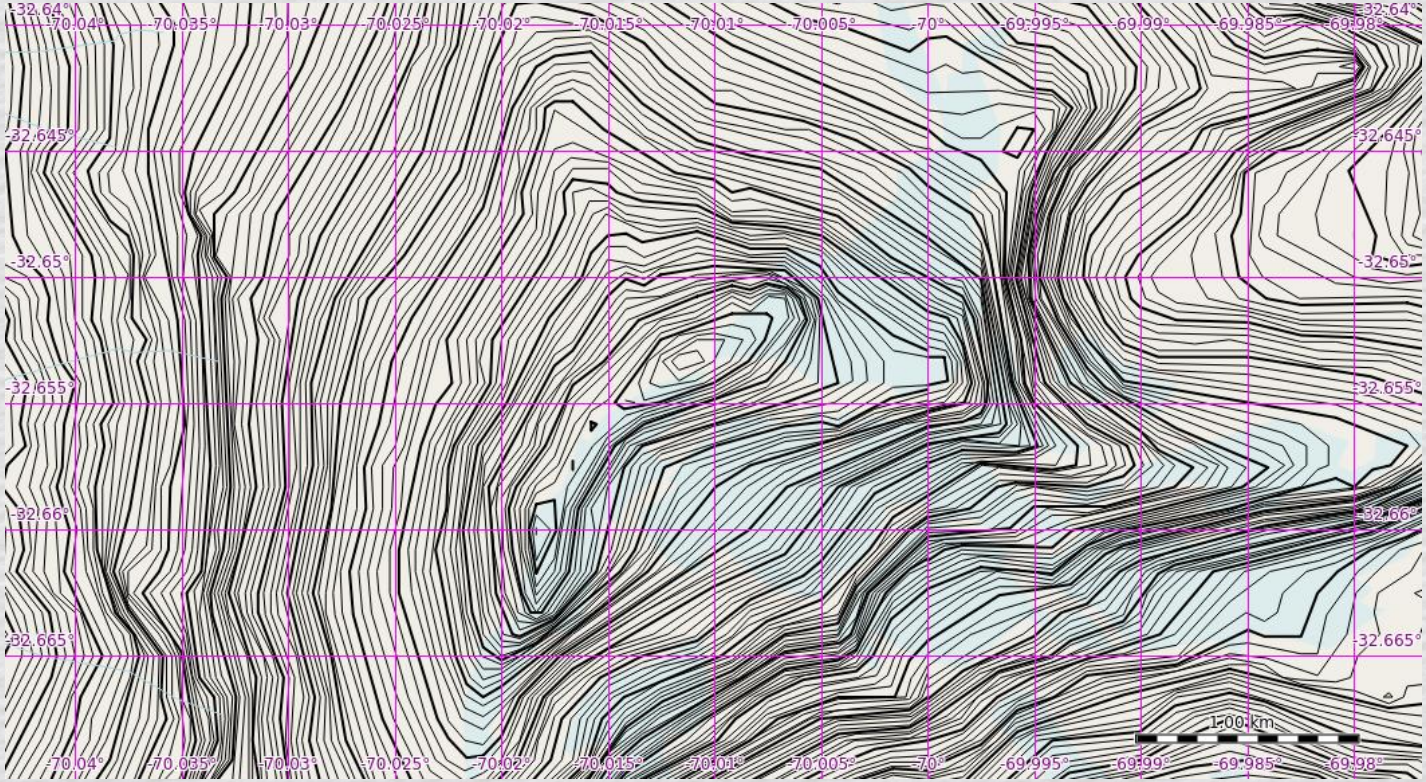
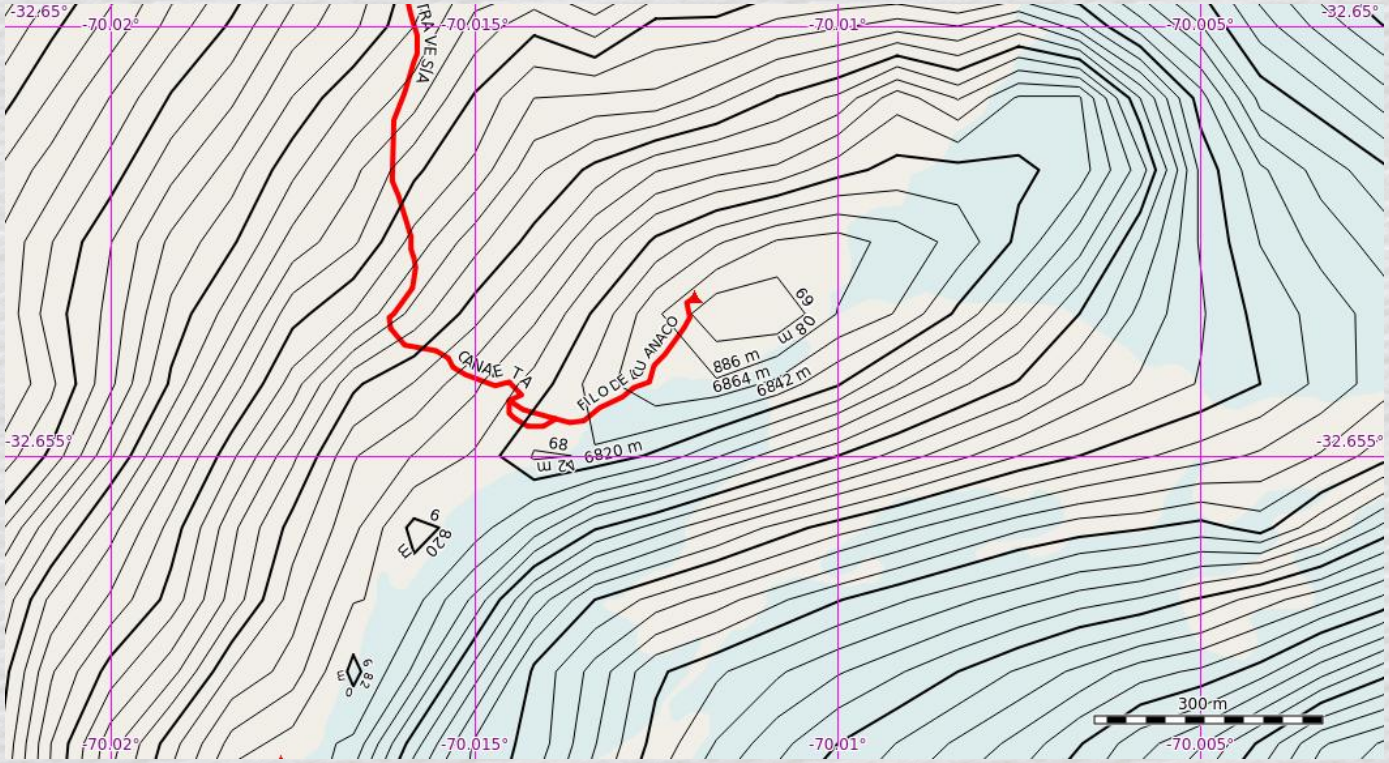
Aconcagua, AR



Aconcagua, AR



Thank You

- Questions ?

- Contact – mappitney@gmail.com

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